

**What is claimed is:**

1. A voltage-controlled oscillator having:  
an inductor circuit having an inductor;  
n pieces (n is two or more) of variable capacitance circuit having a variable capacitance element and having blocking capacitors of interrupting a direct current at both ends thereof, a negative resistance circuit, and reference voltage generation means of generating a reference voltage from a power supply voltage, and wherein:

said inductor circuit, said n pieces of variable capacitance circuit and said negative resistance circuit are connected in parallel;

a predetermined reference voltage is inputted to some terminals of the variable capacitance elements of said n pieces of variable capacitance circuit;

a control voltage of feedback-controlling an oscillation frequency is inputted to the other terminals of the variable capacitance elements of said n pieces of variable capacitance circuits; and

of said n pieces of variable capacitance circuits, the predetermined reference voltage inputted to one of the terminals of the variable capacitance elements of at least two of said n pieces of variable capacitance circuit is different.

2. The voltage-controlled oscillator according to claim 1, wherein, when said  $n$  pieces of variable capacitance circuits are arranged in decreasing order of reference voltages inputted to said  $n$  pieces of variable capacitance circuits, a difference between the voltage inputted to one terminal of the variable capacitance element of an  $m$ -th ( $m$  is between 2 and  $n$ ) variable capacitance circuit and the voltage inputted to one terminal of the variable capacitance element of an  $m-1$ -th variable capacitance circuit is  $V_d$ .

3. The voltage-controlled oscillator according to claim 1, wherein said reference voltage generation means has series-connected  $n+1$  pieces of resistor, and said  $n$  pieces of reference voltage are generated by having said power supply voltage divided by said series-connected  $n+1$  pieces of resistor.

4. The voltage-controlled oscillator according to claim 1, wherein said reference voltage generation means has series-connected one resistor and  $n$  pieces of diode, and said  $n$  pieces of reference voltage are generated by having said power supply voltage divided by said series-connected one resistance and  $n$  pieces of diode.

5. The voltage-controlled oscillator according to claim 4, wherein said diodes are formed by transistors having bases and collectors thereof shorted.

6. The voltage-controlled oscillator according to claim 3, wherein said reference voltage generation means further has an active filter.

7. The voltage-controlled oscillator according to claim 1, wherein said reference voltage generation means has series-connected one active filter and n pieces of resistors, and said n pieces of reference voltage are generated by having said power supply voltage divided by said series-connected one active filter and n pieces of resistors.

8. The voltage-controlled oscillator according to claim 1, wherein output sides of outputting said reference voltages of said reference voltage generation means are grounded via capacitive elements respectively.

9. A voltage-controlled oscillator according to claim 1, further having connected in parallel thereto a frequency band setting variable capacitance circuit having a variable capacitance element, having a power supply voltage inputted to one terminal of said variable capacitance element and having a voltage according to a frequency band to be used of a plurality of voltages inputted to the other terminal of said variable capacitance element so as to change a capacitance of said variable capacitance element, wherein, when the capacitance of the variable capacitance element of said first variable capacitance circuit becomes less than a predetermined value, a variable range is reduced as to the capacitance of at least

one variable capacitance circuit of said n pieces of variable capacitance circuit.

10. The voltage-controlled oscillator according to claim 9, wherein at least one variable capacitance circuit of said n pieces of variable capacitance circuit has the variable capacitance element connected in parallel to said variable capacitance element, and the voltage according to a frequency to be used of said plurality of voltages is inputted to the other terminal of one of said variable capacitance elements instead of said control voltage so that the variable range is reduced as to the capacitance of at least one variable capacitance circuit of said n pieces of variable capacitance circuit according to the reduction in the capacitance of the variable capacitance element of said frequency band setting variable capacitance circuit.

11. The voltage-controlled oscillator according to claim 9, wherein said blocking capacitor is comprised of two or more capacitors connected via a switch, and said switch is off or on according to the frequency to be used so that the capacitance of said blocking capacitors is reduced and a variable range of the capacitance of at least one of said n pieces of variable capacitance circuit is reduced.

12. The voltage-controlled oscillator according to claim 1, wherein said variable capacitance element operates by utilizing a gate capacitance of an MOS transistor.

13. A voltage-controlled oscillator having:  
an inductor circuit having an inductor;  
n pieces (n is two or more) of variable capacitance circuit  
having a variable capacitance element, and a negative  
resistance circuit, and wherein:

said inductor circuit, said n pieces of variable  
capacitance circuit and said negative resistance circuit are  
connected in parallel, and a control voltage of  
feedback-controlling an oscillation frequency is inputted to  
some terminals of the variable capacitance elements of said  
n pieces of variable capacitance circuit;

and

of said n pieces of variable capacitance circuits,  
capacitance variation characteristics against voltage of the  
variable capacitance elements of at least two thereof are  
different.

14. The voltage-controlled oscillator according to claim 13,  
wherein said variable capacitance elements of which  
capacitance variation characteristics are different against  
the voltage are implemented by MOS capacitance of different  
impurity concentrations.

15. The voltage-controlled oscillator according to claim 13,  
wherein said variable capacitance elements of which  
capacitance variation characteristics are different against  
the voltage are implemented by the MOS capacitance utilizing

a p-channel MOS and the MOS capacitance utilizing an n-channel MOS.

16. The voltage-controlled oscillator according to claim 13, wherein said variable capacitance elements of which capacitance variation characteristics are different against the voltage are implemented by the MOS capacitance of which terminals are a gate and a drain-source and the MOS capacitance of which terminals are the gate and a well.

17. A radio communication apparatus having a PLL circuit of outputting a signal of a target frequency having the voltage-controlled oscillator according to claim 1 or 13.

18. A voltage-controlled oscillation method of a voltage-controlled oscillator having:

an inductor circuit having an inductor;

n pieces (n is two or more) of variable capacitance circuit having a variable capacitance element and having blocking capacitors of interrupting a direct current at both ends thereof, a negative resistance circuit, and reference voltage generation means of generating a reference voltage from a power supply voltage, with said inductor circuit, said n pieces of variable capacitance circuit and said negative resistance circuit connected in parallel, and wherein there are:

a step of inputting a predetermined reference voltage to some terminals of the variable capacitance elements of said n pieces of variable capacitance circuit; and

a step of inputting a control voltage of feedback-controlling an oscillation frequency to the other terminals of the variable capacitance elements of said n pieces of variable capacitance circuits, and

the predetermined reference voltage inputted to one of the terminals of the variable capacitance elements of at least two of said n pieces of variable capacitance circuit is different.